Assignment

SCS 2201 - Data Structures and Algorithms III

Greedy Algorithms

Question 01

Sandun is a wine lover. He had to be in his home for three months due to the Covid-19 situation. Sandun wants to buy some wine since the curfew has been lifted. He goes to his favorite wine yard with some empty bottles. Wine yard owner is pleased to see Sandun. Hence, he offers Sandun free wine on one condition. Sandun can fill only the bottles he carries in his bag.

Wine barrels in the wine yard have a tag in each one of them which has two values containing the number of bottles in the barrel and the price of the whole barrel.

You have to build a program to help Sandun to take maximum valued wine from this offer. Given the number of bottles that he brought and the information on the wine barrels, you have to find the maximum value of wines Sandun gets from this deal.

Please note that he cannot fill any of the bottles with more than one type of wine. Assume that the bottle is a 750ml glass bottle.

Input Format

First Line contains two integers N and M. N is the number of bottles Sandun brought and M is the number of barrels in the wine yard.
Second-line contains M space-separated integers contain the volume of barrels in bottles.
The third line contains the M space-separated integers containing the price of each barrel.

Output Format

One integer containing the maximum value of wines Sandun gets from the offer.

Sample Input

```
5 3
1 2 3
6 10 12
```

Sample Output

```
24
```

Explanation

He can fill one bottle from 1st barrel, two bottles from 2nd barrel and another 2 bottles from third barrel which gives maximum value of 24.

Question 02

Manel is a school teacher. She wants to give some face masks to the students in her class. All the students sit in a line and each of them has a score according to his or her performance in the class. Students can't change their seating order. Manel wants to give at least 1 face mask to each student. If two students sit next to each other, then the one with the higher score must get more face masks. Note that when two children have equal score, they are allowed to have different number of face masks. Manel wants to minimize the total number of face masks she must buy.

For example, assume her students' scores are [4, 6, 4, 5, 6, 2]. She gives the students face mask in the following minimal amounts: [1, 2, 1, 2, 3, 1]. She must buy a minimum of 10 face masks.

You have to develop a program to help her find the minimum number of face masks she should buy.

Input Format

The first line contains an integer, **n**, the number of students to give face masks.
Each of the next **n** lines contains an integer **score[i]** indicating the score of the student at position **i**.

Constraints

$1 \le n \le 10^5$
$1 \le score[i] \le 10^5$

Output Format

Output a single line containing the minimum number of face masks Manel must buy.

Sample Input

```
3
1
2
2
```

Sample Output

```
4
```

Explanation

Here 1, 2, 2 is the score. Note that when two children have equal score, they are allowed to have different number of face masks. Hence optimal distribution will be 1, 2, 1.

Question 03

Seetha works for an online store that uses air mail to send ordered products. But due to the covid-19 situation they have to ship the products using containers. Her task is to the determine the lowest cost way to combine her orders for shipping. She has a list of product weights. The shipping company has a requirement that all products loaded in a container must weigh less than or equal to 4 units plus the weight of the minimum weight product. Otherwise they will not take responsibility for addresses getting defaced. All products meeting that requirement will be shipped in one container.

You have to develop a program to find minimum number of containers required.

For example, there are products with weights **w=[1,2,3,4,5,10,11,12,13]**. This can be broken into two containers: **[1,2,3,4,5]** and **[10,11,12,13]**. Each container will contain products weighing within 4 units of the minimum weight product.

Input Format

The first row includes an integer n, the number of shipping products.

The next line includes the weight sequence of products in n space-separated integers.

Constraints

$1 \leq n \leq 10^5$
$0 \leq weight \leq 10^4$

Output Format

Return single integer containing minimum number of containers needed.

Sample Input

```
8
1 2 3 21 7 12 14 21
```

Sample Output

```
4
```

Explanation

We need 4 containers.
1st one can hold 1,2 and 3.
2nd one to hold 7.
3rd one can hold 12 and 14.
Finally, 4th one can hold both products weighing 21.